ES-4810 Chassis
User's Manual

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WARNING: Changes or modifications to this unit not expressly approved by the party responsible for compliance could void this user's authority to operate this equipment.

NOTE: The ES-4810 has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of the equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

DOC CLASS A NOTICE

This digital apparatus does not exceed Class A limits for radio noise emission for a digital device as set out in the Radio Interference Regulations of the Canadian Department of Communications.

Le present appareil numerique n'emet pas de bruits radioelectriques depassant les limites applicables aux appareils numeriques de la class A prescrites dans le reglement sur le brouillage radioelectrique edicte par le ministere des Communications du Canada.

CE NOTICE

Marking by the symbol **CE** indicates compliance of this system to the EMC (Electromagnetic Compatibility) directive of the European Community and compliance to the Low Voltage (Safety) Directive. Such marking is indicative that this system meets or exceeds the following technical standards:

- EN 55022 - "Limits and Methods of Measurement of Radio Interference Characteristics of Information Technology Equipment."
- EN 50082-1 - "Electromagnetic compatibility - Generic immunity standard Part 1: Residential, commercial, and light industry."

CERTIFICATIONS

ETL certified to meet Information Technology Equipment safety standards UL 1950 3rd Edition, CSA22.2, No. 950-95, and EN 60950.

TRADEMARKS

Table of Contents

List of Figures

Preface

CHAPTER 1 Introduction

1.1 ES-4810 Chassis Description . . . . . 1 - 3
1.1.1 Chassis Backplane . . . . . 1 - 4
1.2 Chassis Features . . . . . 1 - 5
1.2.1 Chassis Ventilation . . . . . 1 - 5
1.2.2 Power Supply . . . . . 1 - 6
1.2.3 Advanced Contact Power System . . . . . 1 - 7

CHAPTER 2 Unpacking and Installation

2.1 Chassis Set Up and Power Up . . . . . 2 - 1
2.2 Installing Modules in an ES-4810 Chassis . . . . . 2 - 4
2.2.1 Inserting Modules . . . . . 2 - 4
2.2.2 Removing Modules from a Chassis . . . . . 2 - 6

CHAPTER 3 Product Specifications

3.1 Physical Specifications . . . . . 3 - 1
3.1.1 Configuration . . . . . 3 - 1
3.2 Electrical Specifications . . . . . 3 - 2
3.3 Environmental Specifications . . . . . 3 - 3
3.3.1 Electromagnetic susceptibility . . . . . 3 - 3
3.3.2 Electromagnetic emissions . . . . . 3 - 3

Glossary

Index

List of Figures

CHAPTER 1 Introduction

Figure 1.1 Fully-loaded ES-4810 Chassis . . . . . 1 - 2
Figure 1.2 ES-4810 Chassis . . . . . 1 - 3
Figure 1.3 Physical Location of Chassis Backplanes . . . . . 1 - 4
Figure 1.4 Advanced Contact Power Pins . . . . . 1 - 7
Figure 1.5 Connecting a Module to Power in the Chassis . . . . . 1 - 8

CHAPTER 2 Unpacking and Installation

Figure 2.1 Connecting Power Cords to the Power Supplies . . . . . 2 - 2
Figure 2.2 Insert/Extract Levers . . . . . 2 - 4
Figure 2.3 Securing the Module to the Chassis . . . . . 2 - 5

CHAPTER 3 Product Specifications

Preface

This manual describes the FORE Systems ES-4810 chassis. It provides information about the chassis and power supplies, and on how to physically install modules in the chassis. This manual is for users with various levels of experience. If you have any questions or problems with the installation, please contact FORE Systems' Technical Assistance Center (TAC) using the information on page ii.

Chapter Summaries

Chapter 1 - Introduction - Provides a physical description of the chassis, backplane, and power supply system.

Chapter 2 - Unpacking and Installation - Contains information related to the unpacking and the physical installation of the chassis and procedures for installing modules in the chassis.

Chapter 3 - Product Specifications - Describes the physical, electrical, and environmental specifications for the ES-4810 chassis.

Technical Support

In the U.S.A., customers can reach FORE Systems' Technical Assistance Center (TAC) using any one of the following methods:

1. Select the "Support" link from FORE's World Wide Web page:

   http://www.fore.com/

2. Send questions, via e-mail, to:

   support@fore.com

3. Telephone questions to "support" at:

   800-671-FORE (3673) or **724-742-6999**

4. FAX questions to "support" at:

   724-742-7900

Technical support for customers outside the United States should be handled through the local distributor or via telephone at the following number:

+1 724-742-6999

No matter which method is used to reach the TAC, customers should be ready to provide the following:

- A support contract ID number
- The serial number of each product in question
- All relevant information describing the problem or question

Applicable Documents

FORE Systems provides the appropriate documentation to help you install and configure your ES-4810 chassis and network modules. In addition, the documents listed below provide related information that you may find useful.

Title	Reference Document
ES-4810 Management Module Operations Guide	MANU0296
ES-4810 Ethernet Module Operations Guide	MANU0297
ES-4810 ATM Uplink User's Manual	MANU0294
Structure and Identification of Management Information for TCP/IP-based Internets	RFC 1155, May 1990
A Simple Network Management Protocol	RFC 1157, May 1990
Concise MIB Definitions	RFC 1212
Management Information Base of Network Management of TCP/IP-based Internets: MIB II	RFC 1213
Extensions to the Generic Interface MIB	RFC 1229
Introduction to SNMPv2	RFC 1441
Party MIB for SNMPv2	RFC 1447
MIB for SNMPv2	RFC 1450
Evolution of the Interfaces Group of MIB-II	RFC 1573
Definitions of Managed Objects for the Ethernet-like Interface Types	RFC 1643

Typographical Styles

Throughout this manual, all specific commands meant to be entered by the user appear on a separate line in bold typeface. In addition, use of the `Enter` or `Return` key is represented as **<ENTER>**. The following example demonstrates this convention:

cd /usr <ENTER>

File names that appear within the text of this manual are represented in the following style: "... refer to the `README.TXT` file on the CD..."

Command names and GUI control buttons that appear within the text of this manual are represented in the following style: "Choose the **Start** button on the Taskbar."

Parameter names that appear within the text of this manual are represented in the following style: "The **|<***range***>** is an optional part...."

Any messages that appear on the screen during software installation and network interface administration are shown in `Courier` font to distinguish them from the rest of the text as follows:

```
.... Are all four conditions true?
```

Important Information Indicators

To call your attention to safety and otherwise important information that must be reviewed to insure correct and complete installation, as well as to avoid damage to the FORE adapter or your system, FORE Systems utilizes the following *WARNING/CAUTION/NOTE* indicators.

WARNING statements contain information that is critical to the safety of the operator and/or the system. Do not proceed beyond a *WARNING* statement until the indicated conditions are fully understood or met. This information could prevent serious injury to the operator and damage to the FORE adapter, the system, or currently loaded software, and will be indicated as:

WARNING!

Hazardous voltages are present. To lessen the risk of electrical shock and danger to personal health, follow the instructions carefully.

Information contained in CAUTION statements is important for proper installation/operation. Compliance with CAUTION statements can prevent possible equipment damage and/or loss of data and will be indicated as:

CAUTION

You risk damaging your equipment and/or software if you do not follow these instructions.

Information contained in NOTE statements has been found important enough to be called to the special attention of the operator and will be set off from the text as follows:

Steps 1, 3, and 5 are similar to the installation for the computer type above. Review the previous installation procedure before installation in your particular model**.**

Safety Agency Compliance

This preface provides safety precautions to follow when installing a FORE Systems, Inc., product.

Safety Precautions

For your protection, observe the following safety precaution when setting up your equipment:

- Follow all warnings and instructions marked on the equipment.

Symbols

The following symbols appear in this book.

CAUTION

If instructions are not followed, there is a risk of damage to the equipment.

WARNING!

Hazardous voltages are present. If the instructions are not heeded, there is a risk of electrical shock and danger to personal health.

Modifications to Equipment

Do not make mechanical or electrical modifications to the equipment. FORE Systems, Inc., is not responsible for regulatory compliance of a modified FORE product.

CHAPTER 1 Introduction

Thank you for purchasing a FORE Systems ES-4810. This manual describes the ES-4810 chassis, which can contain any of the following modules, depending on the configuration you ordered:

- ATM uplink modules, providing single or dual 155 Mbps connections to an ATM backbone network.
- Management modules. These modules monitor and control the other modules in the same chassis. They implement the latest industry standard Simple Network Management Protocol (SNMP) and allow configuration of the modules, control of ports and access to statistics about network traffic and card performance. The management modules have a terminal port for management through a console interface.
- Ethernet modules, allowing a wide variety of full-duplex 10/100 Mbps fiber and copper connections.
- ATM switch module, expanding the capabilities of the ES-4810 to include the FORE ASX-200BX switch, allowing the easy integration of the ES-4810 into the ATM network.

These modules allow the ES-4810 meet the needs of both workgroups and enterprise level networks. Figure 1.1 shows an ES-4810 chassis fully loaded with a management module, a dual ATM uplink module, and a variety of Ethernet modules.

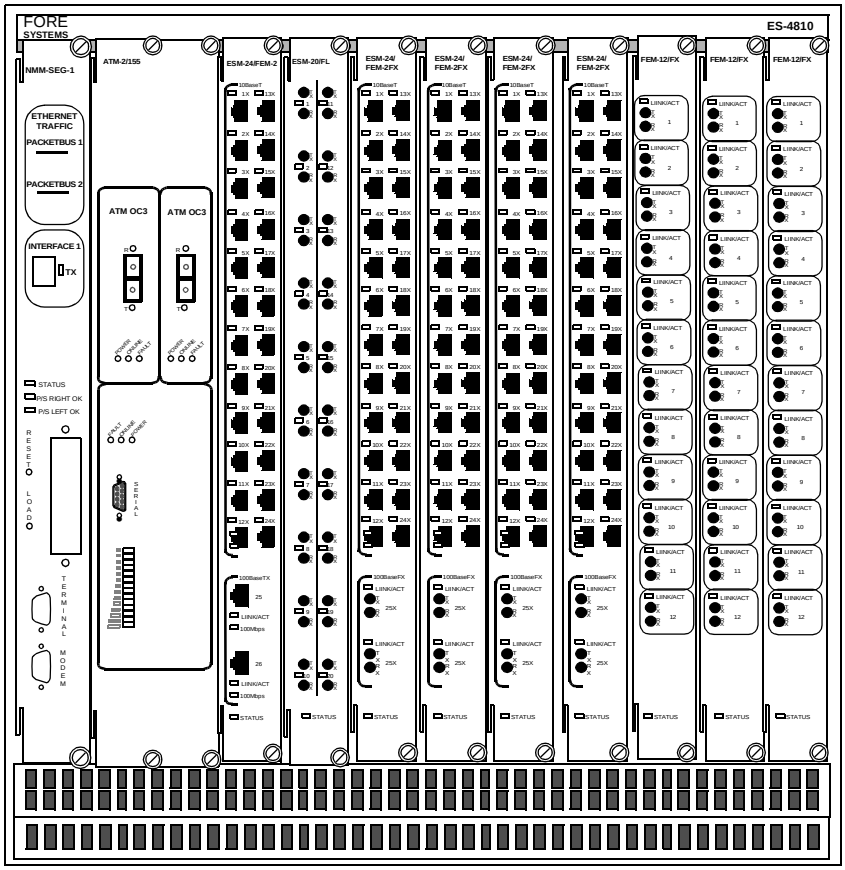

Figure 1.1 - Fully-loaded ES-4810 Chassis

1.1 ES-4810 Chassis Description

Figure 1.2 shows the ES-4810 chassis. The modular design allows you to start with a basic configuration and add more as your network requirements expand.

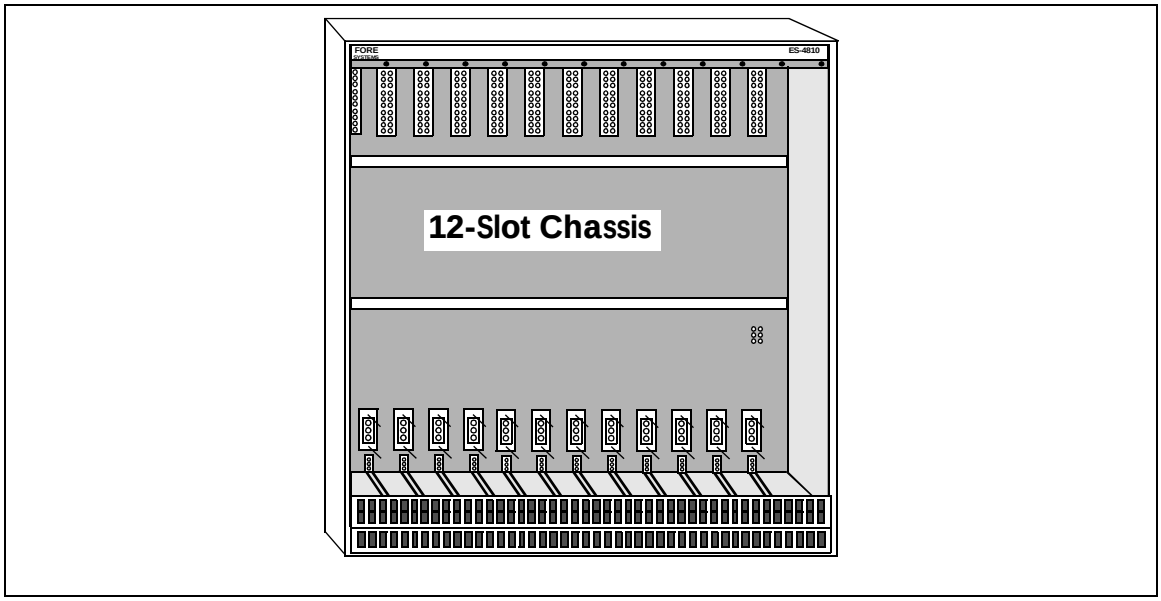

Figure 1.2 - ES-4810 Chassis

1.1.1 Chassis Backplane

An ES-4810 chassis contains a switched Ethernet backplane with a dual packet bus architecture. The backplane is located opposite the control bus and vents, shown in Figure 1.3.

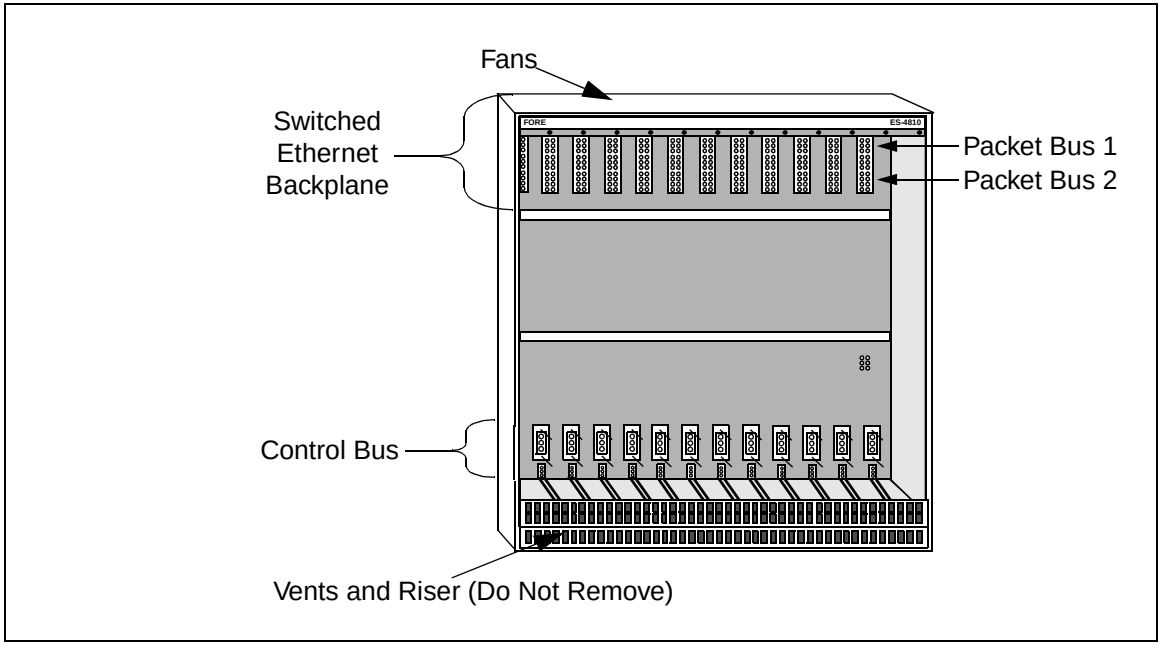

Figure 1.3 - Physical Location of Chassis Backplanes

The switched Ethernet backplane has two independent packet buses as shown in Figure 1-3. Individual network modules can be configured to operate with other modules in the chassis using these packet buses.

The control bus is used to distribute power from the power supply to the network modules. It also provides the bus on which a network management module communicates with the user and uplink modules.

1.2 Chassis Features

The ES-4810 chassis has many features including:

- Active ventilation
- Redundant power supplies with load sharing
- Advanced contact power system

1.2.1 Chassis Ventilation

The chassis is designed to be a stand-alone unit or mounted in a standard 19-inch rack. Air flow is accomplished by fans on the back of the chassis that pull air up through the bottom vents on the front of the chassis, across the cards, and out the top vents in the back.

For proper operation of the equipment, you should ensure that the chassis maintains an ambient temperature of between -5 and 40° C. The ideal operating ambient temperature is 25° C.

Any unused slots on a chassis should have blank slot covers in place. These covers ensure proper ventilation and should only be removed when you are installing new modules. If you have to remove an installed module or power supply from the chassis, you should cover the vacant slot with a blank cover. If you need extra covers, contact FORE Systems' Technical Assistance Center, as described in "Technical Support" on page ii of the Preface.

1.2.2 Power Supply

The ES-4810 chassis can be configured with single or dual power supplies.

It is important to note that when a second power supply is installed in a chassis, the power load is shared between both supplies. If one power supply should fail, the remaining one would continue to operate and therefore provides redundant backup.

The power supplies are mounted in the rear of the chassis and held in place by four screws. If there are two power supplies, one power supply can be removed without completely disconnecting power from the chassis. Before removing a power supply, it must be turned off and the power cord disconnected from it, but the other power supply may remain on. After removing a power supply, you should place a blank cover over the empty slot to maintain proper air flow through the chassis until another power supply is installed.

WARNING!

The chassis contains hazardous voltage when power is applied. To reduce the risk of electrical shock, do not insert hands or other objects inside the chassis while the power is applied.

1.2.3 Advanced Contact Power System

The ES-4810 backplanes also provide the capability to insert and remove network modules with power supplied to the chassis. This “hot” insertion and removal is accomplished by the three-stage advanced contact power system. The control backplane has 128-pin connectors that feature gold-plated advanced contact power pins, shown in Figure 1.4.

When you insert a card into a chassis, it first comes in contact with the advanced contact power pins, as shown in Figure 1.4. The pins provide initial power to the on-board circuitry prior to connection of the data bus.

Once the card is fully inserted, operating power and ground is provided through the blue power connectors.

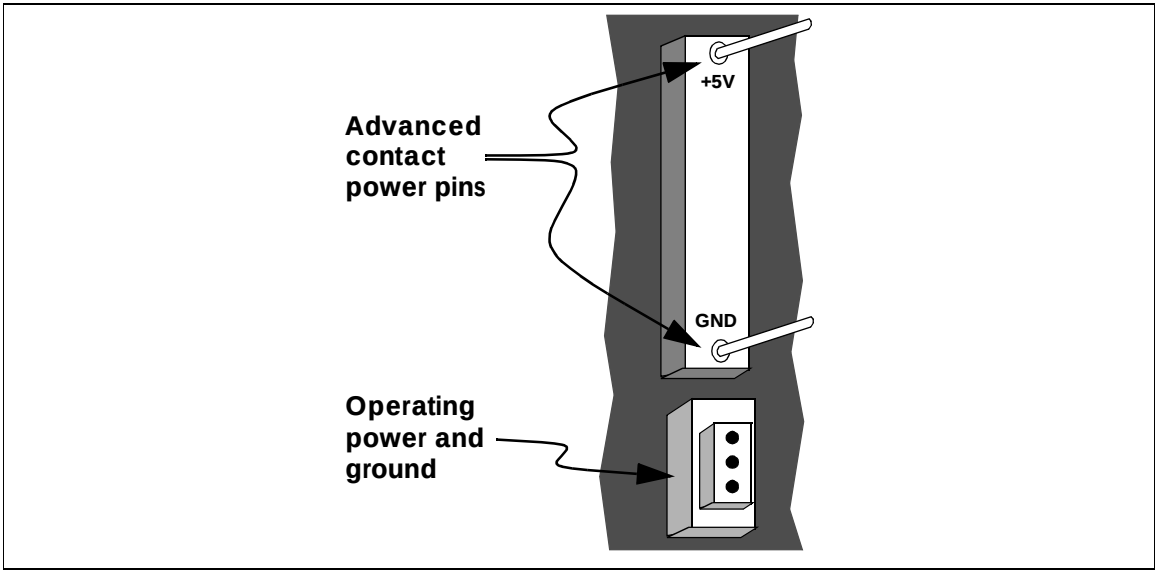

Figure 1.4 - Advanced Contact Power Pins

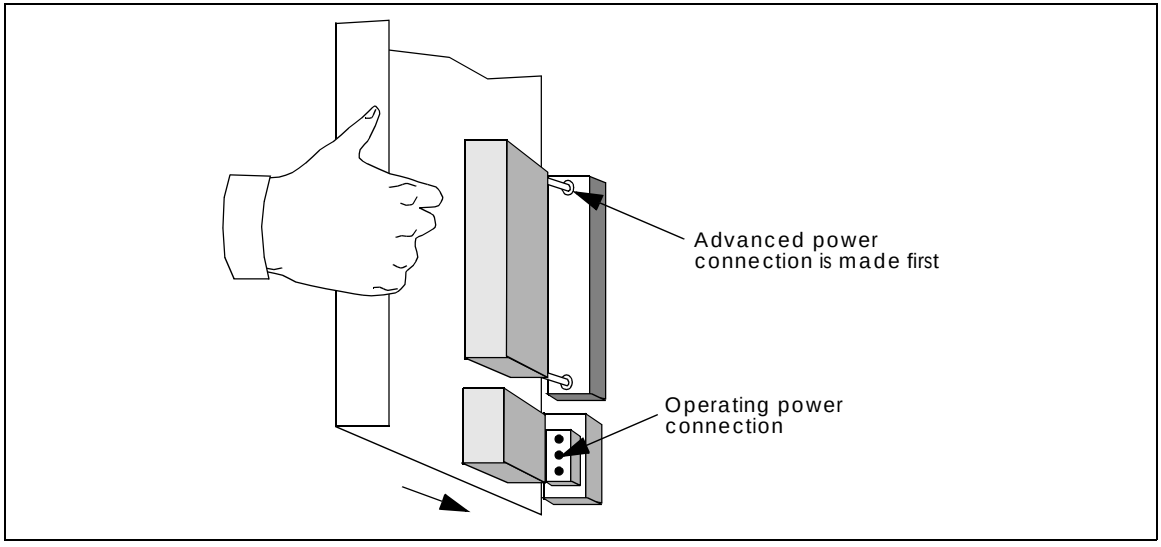

Figure 1.5 - Connecting a Module to Power in the Chassis

CHAPTER 2 Unpacking and Installation

This chapter describes the procedure for unpacking and setting up your new ES-4810 chassis. Also included are the instructions for installing new modules in an existing ES-4810 chassis.

2.1 Chassis Set Up and Power Up

Your ES-4810 product should arrive at your facility in factory-new condition. If you find any problems or damage upon inspection, please contact FORE Systems, Technical Assistance Center (TAC), as described in "Technical Support" on page ii.

Each chassis is delivered with the modules and power supplies that were ordered already installed. A fully loaded chassis can weigh up to 95 lbs. or 49 kg (refer to Table 3.1 on page 3-1). It will take at least two people to lift the chassis from the box.

WARNING!

Do not lift a fully loaded chassis without assistance. To do so may cause severe back injury.

You should receive a power cord for each power supply you ordered. The type of power cord supplied depends on the voltage to be used and whether you are using it in the U.S. or another country. The chassis power supplies automatically switch between 110/220 volts. It is not necessary to set the voltage manually. If you use your own power cords they should meet the specifications shown in Table 3.2 on page 3-2.

To install the chassis at your site, perform the following steps:

1. Unpack the contents from the shipping carton. Be sure to get assistance when lifting the chassis out of the box.You should have the following items:
   - An ES-4810 chassis with the requested network modules already installed
   - A power cord for each power supply (See Table 3.2 on page 3-2)
   - One RS232 cable for each controller card
   - Rack mount ears with screws
   - ES-4810 documentation
2. If this unit will be rack mounted, attach the rack mount ears to the unit with the mounting screws provided.
3. Install the unit in the rack.
4. Make sure that the power switch located on the back of the unit is off (in the "0" position).
5. Plug the power cord(s) into the sockets on each power supply as shown in Figure 2.1.

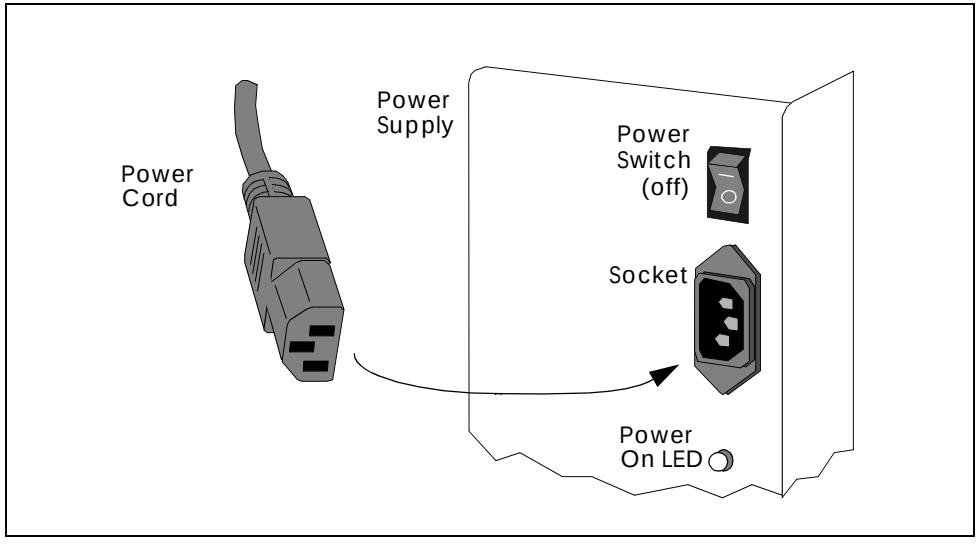

Figure 2.1 - Connecting Power Cords to the Power Supplies

6. Connect the other end of the power cord to the power outlet.

NOTE

If your chassis has two power supplies, you may want to connect them to separate circuits on different breakers to ensure that at least one will remain operational during a power outage.

7. Apply power to the unit by pressing the power switch to the “1” position on one of the power supplies.

   The status lights on the front of the modules in the chassis should briefly illuminate. For each installed power supply, the associated power supply LED should illuminate on the controller module in the chassis.

8. If you have a second power supply, apply power to the unit by pressing the power switch to the “1” position on the second power supplies.
9. Refer to the operations manual for each card in the chassis for configuration and operating instructions.

2.2 Installing Modules in an ES-4810 Chassis

Your chassis should be shipped from the factory with all of the network modules (cards) that you ordered already installed. However, the scalability feature of the ES-4810 chassis allows you to upgrade your network by adding modules at a later time.

The following procedure describes how to install new modules into the ES-4810 chassis.

2.2.1 Inserting Modules

To insert a module in an ES-4810 chassis:

1. Remove the blank face plate covering the slot in which you want to install the new module.
2. Ensure that the module is an ES-4810 module.
3. Holding the card by the bottom edge with one hand, ensure that both insert/extract levers are vertical.

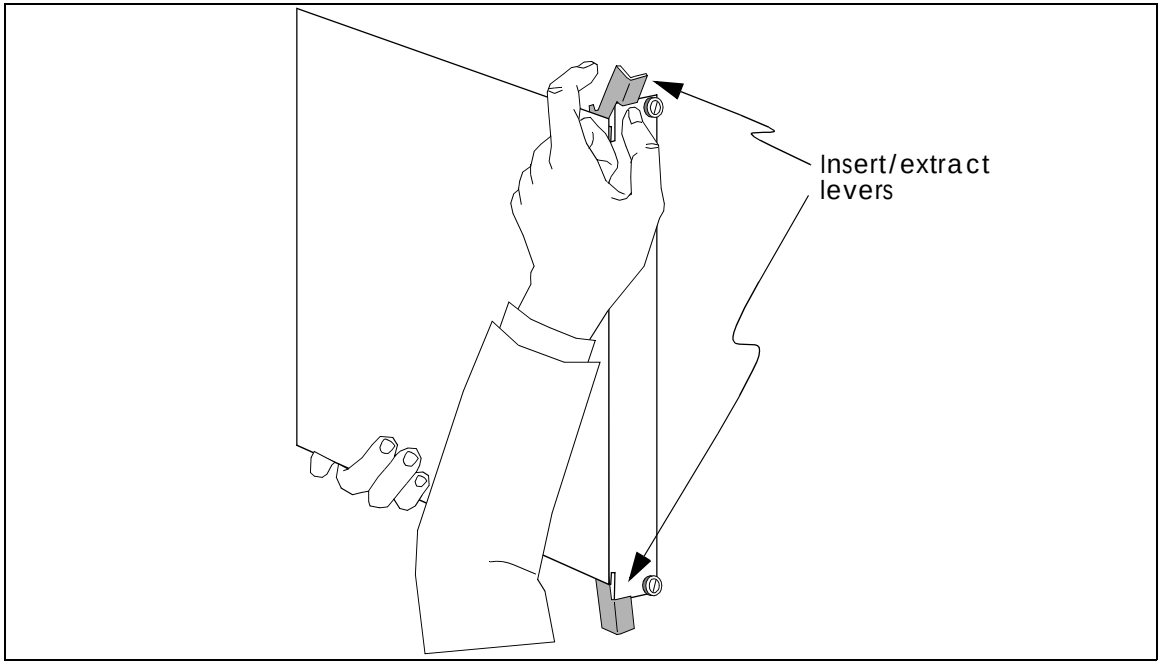

Figure 2.2 - Insert/Extract Levers

4. Place the bottom edge of the circuit card (not the metal carrier plate) in the desired bottom track and the top edge in the top track, then slide the module into the chassis.
5. Press down on the top lever and up on the bottom lever at the same time to seat the module. The module is properly seated when both levers are perpendicular to the module's faceplate (see Figure 2.3).
6. Tighten the mounting screws by hand to secure the module to the chassis (see Figure 2.3). It is not necessary to tighten the mounting screws with a screwdriver.

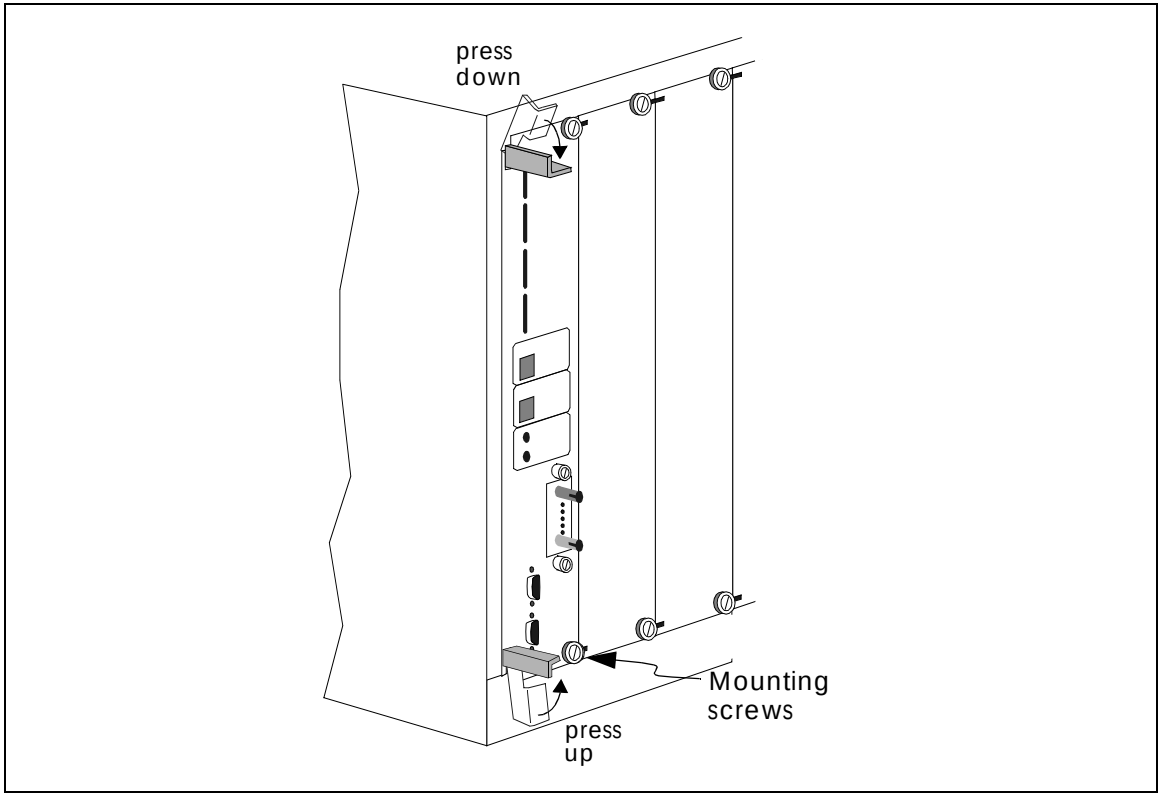

Figure 2.3 - Securing the Module to the Chassis

2.2.2 Removing Modules from a Chassis

To remove a module from an ES-4810 chassis:

1. **Important:** Unscrew the module's mounting screws.
2. Press up on the top lever and down on the bottom lever at the same time.

If you find it difficult to move the levers, check that the mounting screws are fully disconnected. Do not force the levers up or down.

3. Slide the module out of the chassis.
4. Cover the empty slot with a blank face plate. If you need extra face plates, contact FORE Systems Technical Assistance Center (TAC), as described in "Technical Support" on page ii.

CHAPTER 3 Product Specifications

This chapter provides specifications for the following ES-4810 chassis.

3.1 Physical Specifications

Table 3.1 lists the ES-4810 chassis physical specifications.

Table 3.1 - ES-4810 Chassis Physical Specifications

Height	Width	Depth			Weight	
		Chassis only	With power supply	And front & back cables	With backplanes	Fully loaded
21 in. (53.34 cm)	16.98 in. (43.13 cm)	21 in. (52.42 cm)	22.12 in. (56.18 cm)	28.62 in. (72.7 cm)	43.25 lbs (19.62 kg)	95.5 lbs (43.40 kg)

3.1.1 Configuration

The chassis has the following configuration:

- 12-slot
- Switched Ethernet backplane
- 3 cooling fans
- 1 or 2 500W power supplies (7 lbs each)
- 352 Ethernet ports maximum, with one slot being used by an ES-4810 management module.

3.2 Electrical Specifications

FORE Systems ES-4810 equipment complies with both U. S. and European electrical codes and standards. The power supply is shipped with AC cable for standard U. S. outlets. Internal fuses provide overvoltage and short circuit protection. The power supply is 500 watt, 110-220 Vac in.

Table 3.2 lists specifications for power cords.

Table 3.2 - Power Cord Specifications

Units set at:	Power cord specification:
110 V (U. S.)	• UL Listed • Size: minimum No. 18 AWG • Type: SVT or SVJ three conductor cord • Maximum length: 15 feet • Plug:parallel blade with grounding-type attachment, rated 15 A, 250 V
220 V (U. S.)	• UL Listed • Size: minimum No. 18 AWG • Type: SVT or SVJ three conductor cord • Maximum length: 15 feet • Plug:tandem blade, grounding-type attachment rated15 A, 250 V
220 V (non-U. S.)	The cord set used should have the appropriate safety approvals for the country in which the equipment will be installed and should be marked **HAR**. • Size: minimum No. 18 AWG • Plug:grounding-type attachment rated 15 A, 250 V

3.3 Environmental Specifications

The following specifications apply to all of the ES-4810 chassis.

Operating temperature:	-5° C to 40°C
Operating humidity:	85% maximum relative humidity, non-condensing
Operating altitude:	10,000 ft (3,048 m)
Storage temperature:	-25° C to 70° C
Storage humidity:	95% maximum relative humidity, non-condensing
Maximum heat output:	4,270 btu / hour

3.3.1 Electromagnetic susceptibility

Each chassis also meets the following codes for the specified categories.

Electrostatic discharge (ESD):	IEC 801-2, Level 2 / 4
Radiated electromagnetic field:	IEC 801-2, Level 2
Electrical fast transient/burst:	IEC 801-4, Level 2 / 3
Electrical surge:	IEC 801-5, Level 1 / 3

3.3.2 Electromagnetic emissions

The ES-4810 chassis meets the following published standards and codes:

- FCC Part 15, Class A
- EN55022:1993, Class A

Glossary

802.1d Spanning Tree Bridging - the IEEE standard for bridging; a MAC layer standard for transparently connecting two or more LANs (often called subnetworks) that are running the same protocols and cabling. This arrangement creates an extended network, in which any two workstations on the linked LANs can share data.

802.3 Ethernet - the IEEE standard for Ethernet; a physical-layer standard that uses the CSMA / CD access method on a bus-topology LAN.

802.5 Token Ring - the IEEE physical-layer standard that uses the token-passing access method on a ring-topology LAN.

AAL (ATM Adaptation Layer) - the AAL divides the user information into segments suitable for packaging into a series of ATM cells. There are several types of AALs in use. FORE Systems currently supports AAL 5 and AAL 3/4. AAL 3/4 supports connection-oriented VBR data transfer and connectionless VBR data transfer, respectively. AAL 5 is defined as Simple and Efficient Adaptation Layer (SEAL).

AAL Connection - an association established by the AAL between two or more next higher layer entities.

ABR (Available Bit Rate) - a type of traffic for which the ATM network attempts to meet that traffic's bandwidth requirements. It does not guarantee a specific amount of bandwidth and the end station must retransmit any information that did not reach the far end.

ACR (Allowable Cell Rate) - parameter defined by the ATM Forum for ATM traffic management. ACR varies between the MCR and the PCR, and is dynamically controlled using congestion control mechanisms.

Address Mask - a bit mask used to identify which bits in an address (usually an IP address) are network significant, subnet significant, and host significant portions of the complete address. This mask is also known as the subnet mask because the subnetwork portion of the address can be determined by comparing the binary version of the mask to an IP address in that subnet. The mask holds the same number of bits as the protocol address it references.

Agent (SNMP) - a component of network- and desktop-management software, such as SNMP, that gathers information from MIBs.

AIS (Alarm Indication Signal) - a line AIS is asserted when a 111 binary pattern is detected in bits 6, 7, 8 of the K2 byte for five consecutive frames. A line AIS is removed when any pattern other than 111 is detected in these bits for five consecutive frames.

alarm - an unsolicited message from a device, typically indicating a problem with the system that requires attention.

AMI (ATM Management Interface) - the user interface to FORE Systems' *ForeThought* switch control software (SCS). AMI lets users monitor and change various operating configurations of FORE Systems switches and network module hardware and software, IP connectivity, and SNMP network management.

ANSI (American National Standards Institute) - a private organization that coordinates the setting and approval of some U.S. standards. It also represents the United States to the International Standards Organization.

API (Application Program Interface) - a language format that defines how a program can be made to interact with another program, service, or other software; it allows users to develop custom interfaces with FORE products.

APP (application program) - a complete, self-contained program that performs a specific function directly for the user.

AppleTalk - a networking protocol developed by Apple Computer for communication between Apple's products and other computers. Independent of the network layer, AppleTalk runs on LocalTalk, EtherTalk and TokenTalk.

ARP (Address Resolution Protocol) - a method used to resolve higher level protocol addressing (such as IP) into the appropriate header data required for ATM; i.e., port, VPI, and VCI; also defines the AAL type to be used.

ASCII (American Standard Code for Information Interchange) - a standard character set that (typically) assigns a 7-bit sequence to each letter, number, and selected control characters.

Assigned Cell - a cell that provides a service to an upper layer entity or ATM Layer Management entity (ATMM-entity).

asxmon - a FORE program that repeatedly displays the state of the switch and of all its active ports.

ATDM (Asynchronous Time Division Multiplexing) - a method of sending information that resembles normal TDM, except that time slots are allocated as needed rather than preassigned to specific transmitters.

ATM (Asynchronous Transfer Mode) - a transfer mode in which the information is organized into cells. It is asynchronous in the sense that the recurrence of cells containing information from an individual user is not necessarily periodic.

ATM Forum - an international non-profit organization formed with the objective of accelerating the use of ATM products and services through a rapid convergence of interoperability specifications. In addition, the Forum promotes industry cooperation and awareness.

ATM Layer link - a section of an ATM Layer connection between two adjacent active ATM Layer entities (ATM-entities).

ATM Link - a virtual path link (VPL) or a virtual channel link (VCL).

ATM Peer-to-Peer Connection - a virtual channel connection (VCC) or a virtual path connection (VPC) directly established, such as workstation-to-workstation. This setup is not commonly used in networks.

ATM Traffic Descriptor - a generic list of parameters that can be used to capture the intrinsic traffic characteristics of a requested ATM connection.

ATM User-to-User Connection - an association established by the ATM Layer to support communication between two or more ATM service users (i.e., between two or more next higher layer entities or between two or more ATM entities). The communication over an ATM Layer connection may be either bidirectional or unidirectional. The same Virtual Channel Identifier (VCI) is used for both directions of a connection at an interface.

atmarp - a FORE program that shows and manipulates ATM ARP entries maintained by the given device driver. This is also used to establish PVC connections.

atmconfig - a FORE program used to enable or disable SPANS signalling.

atmstat - a FORE program that shows statistics gathered about a given adapter card by the device driver. These statistics include ATM layer and ATM adaptation layer cell and error counts. This can also be used to query other hosts via SNMP.

AUI (Attachment User Interface) - IEEE 802.3 interface between a media attachment unit (MAU) and a network interface card (NIC). The term AUI can also refer to the rear panel port to which an AUI cable might attach.

Auto-logout - a feature that automatically logs out a user if there has been no user interface activity for a specified length of time.

B8ZS (Bipolar 8 Zero Substitution) - a line coding technique used to accommodate the ones density requirements of T1 facilities.

Backbone - the main connectivity device of a distributed system. All systems that have connectivity to the backbone connect to each other. This does not stop systems from setting up private arrangements with each other to bypass the backbone for cost, performance, or security.

Bandwidth - usually identifies the capacity or amount of data that can be sent through a given circuit; may be user-specified in a PVC.

baud - unit of signalling speed. The speed in baud is the number of discrete conditions or signal events per second. If each signal event represents only one bit, the baud rate is the same as bps; if each signal event represents more than one bit (such as a dibit), the baud rate is smaller than bps.

BECN (Backward Explicit Congestion Notification) - bit set by a Frame Relay network in frames traveling in the opposite direction of frames encountering a congested path. Data terminal equipment (DTE) receiving frames with the BECN bit set can request that higher-level protocols take flow control action as appropriate. Compare with *FECN*.

BES (Bursty Errored Seconds) - a BES contains more than 1 and fewer than 320 path coding violation error events, and no severely errored frame or AIS defects. Controlled slips are not included in determining BESs.

BGP (Border Gateway Protocol) - used by gateways in an internet connecting autonomous networks. It is derived from experiences learned using the EGP.

BIP (Bit Interleaved Parity) - an error-detection technique in which character bit patterns are forced into parity, so that the total number of one bits is always odd or always even. This is accomplished by the addition of a one or zero bit to each byte, as the byte is transmitted; at the other end of the transmission, the receiving device verifies the parity (odd or even) and the accuracy of the transmission.

B-ISDN (Broadband Integrated Services Digital Network) - a common digital network suitable for voice, video, and high-speed data services running at rates beginning at 155 Mbps.

BNC (Bayonet-Neill-Concelman) - a bayonet-locking connector for miniature coax.

BPDU (Bridged Protocol Data Unit) - Spanning-tree Protocol hello packet that is sent out at configurable intervals to exchange information among bridges in the network.

bps (bits per second) - a measure of speed or data rate. Often combined with metric prefixes in kbps for thousands of bits per second (k fir kilo-) and in Mbps for millions of bits per second (M for mega-).

BPV (Bipolar Violation) - an error event on a line in which the normal pattern of alternating high (one) and low (zero) signals is disrupted. A bipolar violation is noted when two high signals occur without an intervening low signal, or vice versa.

Bridge - a device that expands a Local Area Network by forwarding frames between data link layers associated with two separate cables, usually carrying a common protocol. Bridges can usually be made to filter certain packets (to forward only certain traffic).

Broadband - a service or system requiring transmission channels capable of supporting rates greater than the Integrated Services Digital Network (ISDN) primary rate.

Broadband Access - an ISDN access capable of supporting one or more broadband services.

Brouter (bridging/router) - a device that routes some protocols and bridges others based on configuration information.

Bursty Second - a second during which there were at least the set number of BES threshold event errors but fewer than the set number of SES threshold event errors.

BUS (Broadcast and Unknown Server) - in an emulated LAN, the BUS is responsible for accepting broadcast, multicast, and unknown unicast packets from the LECs to the broadcast MAC address (FFFFFFFFFFFF) via dedicated point-to-point connections, and forwarding the packets to all of the members of the ELAN using a single point-to-multipoint connection.

CAC (Connection Admission Control) - the procedure used to decide if a request for an ATM connection can be accepted based on the attributes of both the requested connection and the existing connections.

Call - an association between two or more users or between a user and a network entity that is established by the use of network capabilities. This association may have zero or more connections.

Carrier - a company, such as any of the "baby Bell" companies, that provide network communications services, either within a local area or between local areas.

CBR (Constant Bit Rate) - a type of traffic that requires a continuous, specific amount of bandwidth over the ATM network (e.g., digital information such as video and digitized voice).

CBR port - a port on the *CellPath* 300 for transmitting and receiving CBR traffic.

cchan - a FORE program used to manage virtual channels on a FORE Systems ATM switch running asxd.

CCITT (Consultative Committee for International Telephone and Telegraph) - an international consultative committee that sets international communications recommendations, which are frequently adopted as standards; develops interface, modem, and data network recommendations. Membership includes PTTs, scientific and trade associations, and private companies. CCITT is part of the International Communications Union (a United nations treaty organization in Geneva).

CDV (Cell Delay Variation) - a quantification of cell clumping for a connection. The cell clumping CDV (yk) is defined as the difference between a cell's expected reference arrival time (ck) and its actual arrival time (ak). The expected reference arrival time (ck) of cell k of a specific connection is max $[c_{\{k-1\}} + T, a_k]$. T is the reciprocal of the negotiated peak cell rate.

CE (Connection Endpoint) - a terminator at one end of a layer connection within a SAP.

CEI (Connection Endpoint Identifier) - an identifier of a CE that can be used to identify the connection at a SAP.

Cell - an ATM Layer protocol data unit (PDU). The basic unit of information transported in ATM technology, each 53-byte cell contains a 5-byte header and a 48-byte payload.

Cell Delineation - the protocol for recognizing the beginning and end of ATM cells within the raw serial bit stream.

Cell Header - ATM Layer protocol control information.

Cell Port - a port on the *CellPath* 300 that transmits and receives traffic in cell format.

Cell Rate Adaptation - a function performed by a protocol module in which empty cells (known as unassigned cells) are added to the output stream. This is because there always must be a fixed number of cells in the output direction; when there are not enough cells to transmit, unassigned cells are added to the output data stream.

Cell Transfer Delay - the transit delay of an ATM cell successfully passed between two designated boundaries.

CES (Circuit emulation Services) - The *CellPath* 90 supports Circuit Emulation Services (CES) for applications requiring a fixed delay, lossless end-to-end connection through the network. In essence, CES provides a virtual private line service to the connecting application.

Channelization - capability of transmitting independent signals together over a cable while still maintaining their separate identity for later separation.

CLP (Cell Loss Priority) - the last bit of byte four in an ATM cell header; indicates the eligibility of the cell for discard by the network under congested conditions. If the bit is set to 1, the cell may be discarded by the network depending on traffic conditions.

Cold Start Trap - a *CellPath* 300 SNMP trap which is sent when the unit has been power-cycled (*see* trap).

Comm Port - the front panel DCE port that allows access to the *CellPath* 300 user interface via a connected terminal.

Community String - the password that allows an SNMP manager to access the agent information. Each request from a manager is accompanied by a community string.

Concentrator - a communications device that offers the ability to concentrate many lower-speed channels into and out of one or more high-speed channels.

Congestion Management - a *CellPath* 300 feature that helps ensure reasonable service for VBR connections in an ATM network. For each connection, the *CellPath* 300 maintains a priority, sustained cell rate (SCR), and peak cell rate (PCR). During times of congestion, the *CellPath* 300 reduces the bandwidth to the SCR, based on the priority of the connection.

Connection - the concatenation of ATM Layer links in order to provide an end-to-end information transfer capability to access points.

Connectionless Service - a type of service in which no pre-determined path or link has been established for transfer of information, supported by AAL 4.

Connection-Oriented Service - a type of service in which information always traverses the same pre-established path or link between two points, supported by AAL 3.

Controlled Slip - a situation in which one frame's worth of data is either lost or replicated. A controlled slip typically occurs when the sending device and receiving device are not using the same clock.

Corresponding Entities - peer entities with a lower layer connection among them.

cpath - a FORE program used to manage virtual paths on a FORE Systems ATM switch running asxd.

CPE (Customer Premise Equipment) - equipment that is on the customer side of the point of demarcation, as opposed to equipment that is on a carrier side. *See also* point of demarcation.

cport - a FORE program used to monitor and change the state of ports on a FORE Systems ATM switch running asxd.

CRC (Cyclic Redundancy Check) - an error detection scheme in which a number is derived from the data that will be transmitted. By recalculating the CRC at the remote end and comparing it to the value originally transmitted, the receiving node can detect errors.

Cross Connection - a mapping between two channels or paths at a network device such as the *CellPath* 300.

CD (Controlled Slip) - a situation in which one frame's worth of data is either lost or replicated. A controlled slip typically occurs when the sending device and receiving device are not using the same clock.

CS (Convergence Sublayer) - a portion of the AAL. Data is passed first to the CS where it is divided into rational, fixed-length packets or PDUs (Protocol Data Units). For example, AAL 4 processes user data into blocks that are a maximum of 64 kbytes long.

CTS (Clear To Send) - and RS-232 modem interface control signal (sent from the modem to the DTE on pin 5) which indicates that the attached DTE may begin transmitting; issuance in response to the DTE's RTS.

D4 framing - See SF)

DARPA (Defense Advanced Research Projects Agency) - the US government agency that funded the ARPANET.

Datagram - a packet of information used in a connectionless network service that is routed to its destination using an address included in the datagram's header.

DCE (Data Communications Equipment) - a definition in the RS232C standard that describes the functions of the signals and the physical characteristics of an interface for a communication device such as a modem.

DCS (Digital Cross-connect System) - an electronic patch panel used to route digital signals in a central office.

Demultiplexing - a function performed by a layer entity that identifies and separates SDUs from a single connection to more than one connection (*see* multiplexing).

DFA (DXI Frame Address) - a connection identifier associated with ATM DXI packets that serves the same functions as, and translates directly to, the VPI/VCI on an ATM cell.

DIP Switch (Dual In-line Package) - a device that has two parallel rows of contacts that let the user switch electrical current through a pair of those contacts to on or off. They are used to reconfigure components and peripherals.

DLCI (Data Link Connection Identifier) - a connection identifier associated with frame relay packets that serves the same functions as, and translates directly to, the VPI/VCI on an ATM cell.

Domain Name Server - a computer that converts names to their corresponding Internet numbers. It allows users to telnet or FTP to the name instead of the number.

DNS (Domain Name System) - the distributed name and address mechanism used in the Internet.

DSn (Digital Standard n (0, 1, 1C, 2, and 3)) - a method defining the rate and format of digital hierarchy, with asynchronous data rates defined as follows:

DS0	64kbps	1 voice channel
DS1	1.544Mbps	24 DS0s
DS1C	3.152 Mbps	2 DS1s
DS2	6.312 Mbps	4 DS1s
DS3	44.736 Mbps	28 DS1s

Synchronous data rates (SONET) are defined as:

STS-1/OC-1	51.84 Mbps	28 DS1s or 1 DS3
STS-3/OC-3	155.52 Mbps	3 STS-1s byte interleaved
STS-3c/OC-3c	155.52 Mbps	Concatenated, indivisible payload
STS-12/OC-12	622.08 Mbps	12 STS-1s, 4 STS-3cs, or any mixture
STS-12c/OC-12c	622.08 Mbps	Concatenated, indivisible payload
STS-48/OC-48	2488.32 Mbps	48 STS-1s, 16 STS-3cs, or any mixture

DSR (Data Set Ready) - an RS-232 modem interface control signal (sent from the modem to the DTE on pin 6) which indicates that the modem is connected to the telephone circuit. Usually a prerequisite to the DTE issuing RTS.

DTE (Data Terminal Equipment) - generally user devices, such as terminals and computers, that connect to data circuit-terminating equipment. They either generate or receive the data carried by the network.

DTR (Data Terminal Ready) - an RS232 modem interface control signal (sent from the DTE to the modem on pin 20) which indicates that the DTE is ready for data transmission and which requests that the modem be connected to the telephone circuit.

DXI - a generic phrase used in the full names of several protocols, all commonly used to allow a pair of DCE and DTE devices to share the implementation of a particular WAN protocol. The protocols all define the packet formats used to transport data packets between DCE and DTE devices.

E1 - Wide-area digital transmission scheme used predominantly in Europe that carries data at a rate of 2.048 Mbps. E1 lines can be leased for private use from common carriers.

E3 - Wide-area digital transmission scheme used predominantly in Europe that carries data at a rate of 34.368 Mbps. E3 lines can be leased for private use from common carriers.

EEPROM (Electrically Erasable Programmable Read Only Memory) - an EPROM that can be cleared with electrical signals rather than the traditional ultraviolet light.

EFCI (Explicit Forward Congestion Indication) - the second bit of the payload type field in the header of an ATM cell, the EFCI bit indicates network congestion to receiving hosts. On a congested switch, the EFCI bit is set to "1" by the transmitting network module when a certain number of cells have accumulated in the network module's shared memory buffer. When a cell is received that has its EFCI bit set to "1," the receiving host notifies the sending host, which should then reduce its transmission rate.

EGP (Exterior Gateway) Protocol - used by gateways in an internet, connecting autonomous networks.

EIA (Electronics Industries Association) - a USA trade organization that issues its own standards and contributes to ANSI; developed RS-232. Membership includes USA manufacturers.

EISA (Extended Industry Standard Architecture) - a bus architecture for desktop computers that provides a 32-bit data passage while maintaining compatibility with the ISA or AT architecture.

elarp - a FORE program that shows and manipulates MAC and ATM address mappings for LAN Emulation Clients (LECs).

elconfig - a FORE program that shows and modifies LEC configuration. Allows the user to set the NSAP address of the LAN Emulation Configuration Server (LECS), display the list of Emulated LANs (ELANs) configured in the LECS for this host, display the list of ELANs locally configured along with the membership state of each, and locally administer ELAN membership.

EM - the *CellPath* 300 extension module; paired with the system controller and supporting an optional PCMCIA card.

Embedded SNMP Agent - an SNMP agent can come in two forms: embedded or proxy. An embedded SNMP agent is integrated into the physical hardware and software of the unit. The *CellPath* 300 has an internal, integrated SNMP agent.

EMI (Electromagnetic Interference) - signals generated and radiated by an electronic device that cause interference with radio communications, among other effects.

End-to-End Connection - when used in reference to an ATM network, a connection that travels through an ATM network, passing through various ATM devices and with endpoints at the termination of the ATM network.

EPROM - Erasable Programmable Read Only Memory (*see* PROM).

EQL (Equalization) - the process of compensating for line distortions.

ES (End System) - a system in which an ATM connection is terminated or initiated. An originating end system initiates the ATM connection, and a terminating end system terminates the ATM connection. OAM cells may be generated and received.

ES (Errored Seconds) - a second during which at least one code violation occurred.

ESF (Extended Superframe) - T1 framing standard that provides frame synchronization, cyclic redundancy, and data link bits.

Ethernet - a 10-Mbps, coaxial standard for LANs in which all nodes connect to the cable where they contend for access.

Fairness - as related to Generic Flow Control (GFC), fairness is defined as meeting all of the agreed quality of service (QoS) requirements by controlling the order of service for all active connections.

Far-End - in a relationship between two devices in a circuit, the far-end device is the one that is remote.

FCC - a board of commissioners appointed by the President under the Communications Act of 1934, with the authority to regulate all interstate telecommunications originating in the United States, including transmission over phone lines.

FDDI (Fiber Distributed Data Interface) - high-speed data network that uses fiber-optic as the physical medium. Operates in similar manner to Ethernet or Token Ring, only faster.

FDM (Frequency Division Multiplexing) - a method of dividing an available frequency range into parts with each having enough bandwidth to carry one channel.

FEBE (Far End Block Error) - an error detected by extracting the 4-bit FEBE field from the path status byte (G1). The legal range for the 4-bit field is between 0000 and 1000, representing zero to eight errors. Any other value is interpreted as zero errors.

FECN (Forward Explicit Congestion Notification) - bit set by a Frame Relay network to inform data terminal equipment (DTE) receiving the frame that congestion was experienced in the path from source to destination. DTE receiving frames with the FECN bit set can request that higher-level protocols take flow control action as appropriate. Compare with *BECN*.

FERF (Far End Receive Failure) - a line error asserted when a 110 binary pattern is detected in bits 6, 7, 8 of the K2 byte for five consecutive frames. A line FERF is removed when any pattern other than 110 is detected in these bits for five consecutive frames.

FIFO (First-In, First-Out) - a method of coordinating the sequential flow of data through a buffer.

Flag - a specific bit pattern used to identify the beginning or end of a frame.

Frame - a variable length group of data bits with a specific format containing flags at the beginning and end to provide demarcation.

Frame Relay - a fast packet switching protocol based on the LAPD protocol of ISDN that performs routing and transfer with less overhead processing than X.25.

Frame Synchronization Error - an error in which one or more time slot framing bits are in error.

Framing - a protocol that separates incoming bits into identifiable groups so that the receiving multiplexer recognizes the grouping.

FT-PNNI (ForeThought PNNI) - a FORE Systems routing and signalling protocol that uses private ATM (NSAP) addresses; a precursor to ATM Forum PNNI (*see* PNNI).

FTP (File Transfer Protocol) - a TCP/IP protocol that lets a user on one computer access, and transfer data to and from, another computer over a network. ftp is usually the name of the program the user invokes to accomplish this task.

GCRA (Generic Cell Rate Algorithm) - an algorithm which is employed in traffic policing and is part of the user/network service contract. The GCRA is a scheduling algorithm which ensures that cells are marked as *conforming* when they arrive when expected or later than expected and *non-conforming* when they arrive sooner than expected.

GFC (Generic Flow Control) - the first four bits of the first byte in an ATM cell header. Used to control the flow of traffic across the User-to-Network Interface (UNI), and thus into the network. Exact mechanisms for flow control are still under investigation and no explicit definition for this field exists at this time. (This field is used only at the UNI; for NNI-NNI use (between network nodes), these four bits provide additional network address capacity, and are appended to the VPI field.)

GIO - a proprietary bus architecture used in certain Silicon Graphics, Inc. workstations.

Header - protocol control information located at the beginning of a protocol data unit.

HDB3 (High Density Bipolar) - line-code type standard for T1 where each block of three zeros is replaced by 00V or B0V, where B represents an inserted pulse conforming to the AMI rule (ITU-T G.701, item 9004) and V represents an AMI violation (ITU-T G.701, item 9007). The choice of 00V or B0V is made so that the number of B pulses between consecutive V pulses is odd (successive V pulses are of alternate polarity so that no d.c. component is introduced). Compare with *AMI*.

HDLC (High-Level Data Link Control) - Bit-oriented synchronous data link layer protocol developed by the ISO. Derived from SDLC, HDLC specifies a data encapsulation method on synchronous serial links using frame characters and checksums. See also *SDLC*.

HEC (Header Error Control) - a CRC code located in the last byte of an ATM cell header that is used for checking cell integrity only.

HIPPI (High Performance Parallel Interface) - ANSI standard that extends the computer bus over fairly short distances at speeds of 800 and 1600 Mbps.

HPUX - the Hewlett-Packard version of UNIX.

HSSI (High-Speed Serial Interface) - a serial communications connection that operates at speeds of up to 1.544 Mbps.

Hub - a device that connects several other devices, usually in a star topology.

I/O Module - FORE's interface cards for the LAX-20 LAN Access Switch, designed to connect Ethernet, Token Ring, and FDDI LANs to *ForeRunner* ATM networks.

ICMP (Internet Control Message Protocol) - the protocol that handles errors and control messages at the IP layer. ICMP is actually a part of the IP protocol layer. It can generate error messages, test packets, and informational messages related to IP.

IEEE (Institute of Electrical and Electronics Engineers) - the world's largest technical professional society. Based in the U.S., the IEEE sponsors technical conferences, symposia & local meetings worldwide, publishes nearly 25% of the world's technical papers in electrical, electronics & computer engineering, provides educational programs for members, and promotes standardization.

IETF (Internet Engineering Task Force) - a large, open, international community of network designers, operators, vendors and researchers whose purpose is to coordinate the operation, management and evolution of the Internet to resolve short- and mid-range protocol and architectural issues.

ILMI (Interim Local Management Interface) - the standard that specifies the use of the Simple Network Management Protocol (SNMP) and an ATM management information base (MIB) to provide network status and configuration information.

Interface Data - the unit of information transferred to/from the upper layer in a single interaction across a SAP. Each Interface Data Unit (IDU) controls interface information and may also contain the whole or part of the SDU.

internet - while an internet is a network, the term "internet" is usually used to refer to a collection of networks interconnected with routers.

Internet - (note the capital "I") the largest internet in the world including large national backbone nets and many regional and local networks worldwide. The Internet uses the TCP/IP suite. Networks with only e-mail connectivity are not considered on the Internet.

Internet Addresses - the numbers used to identify hosts on an internet network. Internet host numbers are divided into two parts; the first is the network number and the second, or local, part is a host number on that particular network. There are also three classes of networks in the Internet, based on the number of hosts on a given network. Large networks are classified as Class A, having addresses in the range 1-126 and having a maximum of 16,387,064 hosts. Medium networks are classified as Class B, with addresses in the range 128-191 and with a maximum of 64,516 hosts. Small networks are classified as Class C, having addresses in the range 192-254 with a maximum of 254 hosts. Addresses are given as dotted decimal numbers in the following format:

nnn.nnn.nnn.nnn

In a Class A network, the first of the numbers is the network number, the last three numbers are the local host address.

In a Class B network, the first two numbers are the network, the last two are the local host address.

In a Class C network, the first three numbers are the network address, the last number is the local host address.

The following table summarizes the classes and sizes:

Class	First #	Max# Hosts
A	1-126	16,387,064
B	129-191	64,516
C	192-223	254

Network mask values are used to identify the network portion and the host portion of the address. For:

Class A - the default mask is 255.0.0.0

Class B - the default mask is 255.255.0.0

Class C - the default mask is 255.255.255.0

Subnet masking is used when a portion of the host ID is used to identify a subnetwork. For example, if a portion of a Class B network address is used for a subnetwork, the mask could be set as 255.255.255.0. This would allow the third byte to be used as a subnetwork address. All hosts on the network would still use the IP address to get on the Internet.

IP (Internet Protocol) - a connectionless, best-effort packet switching protocol that offers a common layer over dissimilar networks.

IP Address - a unique 32-bit integer used to identify a device in an IP network. You will most commonly see IP addresses written in “dot” notation; for instance, 192.228.32.14 (*see* IP net-mask).

IP Netmask - a pattern of 32 bits that is combined with an IP address to determine which bits of an IP address denote the network number and which denote the host number. Netmasks are useful for sub-dividing IP networks. IP netmasks are written in "dot" notation; for instance, 255.255.255.0 (*see* IP address).

IPX Protocol (Internetwork Packet Exchange) - a NetWare protocol similar to the Xerox Network Systems (XNS) protocol that provides datagram delivery of messages.

IS (Intermediate system) - a system that provides forwarding functions or relaying functions or both for a specific ATM connection. OAM cells may be generated and received.

ISA Bus - a bus standard developed by IBM for expansion cards in the first IBM PC. The original bus supported a data path only 8 bits wide. IBM subsequently developed a 16-bit version for its AT class computers. The 16-bit AT ISA bus supports both 8- and 16-bit cards. The 8-bit bus is commonly called the PC/XT bus, and the 16-bit bus is called the AT bus.

ISDN (Integrated Services Digital Network) - an emerging technology that is beginning to be offered by the telephone carriers of the world. ISDN combines voice and digital network services into a single medium or wire.

ISO (International Standards Organization) - a voluntary, non treaty organization founded in 1946 that is responsible for creating international standards in many areas, including computers and communications.

Isochronous - signals carrying embedded timing information or signals that are dependent on uniform timing; usually associated with voice and/or video transmission.

ITU (International Telecommunications Union) - the telecommunications agency of the United Nations, established to provide standardized communications procedures and practices, including frequency allocation and radio regulations, on a worldwide basis.

J2 - Wide-area digital transmission scheme used predominantly in Japan that carries data at a rate of 6.312 Mbps.

Jitter - analog communication line distortion caused by variations of a signal from its reference timing position.

Jumper - a patch cable or wire used to establish a circuit, often temporarily, for testing or diagnostics; also, the devices, shorting blocks, used to connect adjacent exposed pins on a printed circuit board that control the functionality of the card.

LAN (Local Area Network) - a data network intended to serve an area of only a few square kilometers or less. Because the network is known to cover only a small area, optimizations can be made in the network signal protocols that permit higher data rates.

lane - a program that provides control over the execution of the LAN Emulation Server (LES), Broadcast/Unknown Server (BUS), and LAN Emulation Configuration Server (LECS) on the local host.

LAN Access Concentrator - a LAN access device that allows a shared transmission medium to accommodate more data sources than there are channels currently available within the transmission medium.

LAPB (Link Access Procedure, Balanced) - Data link protocol in the X.25 protocol stack. LAPB is a bit-oriented protocol derived from HDLC. See also HDLC and X.25.

LAX-20 - a FORE Systems LAN Access Switch, designed to connect Ethernet, Token Ring, and FDDI LANs to *ForeRunner* ATM networks. The LAX-20 is a multiport, multiprotocol internetworking switch that combines the advantages of a high-performance LAN switch and a full-featured ATM interface capable of carrying LAN traffic.

Layer Entity - an active layer within an element.

Layer Function - a part of the activity of the layer entities.

Layer Service - a capability of a layer and the layers beneath it that is provided to the upper layer entities at the boundary between that layer and the next higher layer.

Layer User Data - the information transferred between corresponding entities on behalf of the upper layer or layer management entities for which they are providing services.

le - a FORE program that implements both the LAN Emulation Server (LES) and the Broadcast / Unknown Server (BUS).

LEC (LAN Emulation Client) - the component in an end system that performs data forwarding, address resolution, and other control functions when communicating with other components within an ELAN.

lecs - a FORE program that implements the assignment of individual LECs to different emulated LANs.

LECS (LAN Emulation Configuration Server) - the LECS is responsible for the initial configuration of LECs. It provides information about available ELANs that a LEC may join, together with the addresses of the LES and BUS associated with each ELAN.

leq - a FORE program that provides information about an ELAN. This information is obtained from the LES, and includes MAC addresses registered on the ELAN together with their corresponding ATM addresses.

LES (LAN Emulation Server) - the LES implements the control coordination function for an ELAN. The LES provides the service of registering and resolving MAC addresses to ATM addresses.

Link Down Trap - a *CellPath* 300 SNMP trap that signifies that the Ethernet interface has transitioned from a normal state to an error state, or has been disconnected.

Link Up Trap - a *CellPath* 300 SNMP trap that signifies that the Ethernet interface has transitioned from an error condition to a normal state.

LLC (Logical Link Control) - a protocol developed by the IEEE 802 committee for data-link-layer transmission control; the upper sublayer of the IEEE Layer 2 (OSI) protocol that complements the MAC protocol; IEEE standard 802.2; includes end-system addressing and error checking.

LOF (Loss Of Frame) - a type of transmission error that may occur in wide-area carrier lines.

Loopback - a troubleshooting technique that returns a transmitted signal to its source so that the signal can be analyzed for errors. Typically, a loopback is set at various points in a line until the section of the line that is causing the problem is discovered.

looptest - a program that tests the interface for basic cell reception and transmission functionality. It is usually used for diagnostic purposes to determine if an interface is functioning properly.

LOP (Loss Of Pointer) - a type of transmission error that may occur in wide-area carrier lines.

LOS (Loss Of Signal) - a type of transmission error that may occur in wide-area carrier lines.

MAC (Media Access Control) - a media-specific access control protocol within IEEE 802 specifications; currently includes variations for Token Ring, token bus, and CSMA/CD; the lower sublayer of the IEEE's link layer (OSI), which complements the Logical Link Control (LLC).

MAU (Media Attachment Unit) - device used in Ethernet and IEEE 802.3 networks that provides the interface between the AUI port of a station and the common medium of the Ethernet. The MAU, which can be built into a station or can be a separate device, performs physical layer functions including conversion of the digital data from the Ethernet interface, collision detection, and injection of bits onto the network.

Maximum Burst Tolerance - the largest burst of data that a network device is guaranteed to handle without discarding cells or packets. Bursts of data larger than the maximum burst size may be subject to discard.

MCR (Minimum Cell Rate) - parameter defined by the ATM Forum for ATM traffic management. MCR is defined only for ABR transmissions, and specifies the minimum value for the ACR.

Metasignalling - an ATM Layer Management (LM) process that manages different types of signalling and possibly semipermanent virtual channels (VCs), including the assignment, removal, and checking of VCs.

Metasignalling VCs - the standardized VCs that convey metasignalling information across a User-to-Network Interface (UNI).

MIB (Management Information Base) - the set of parameters that an SNMP management station can query or set in the SNMP agent of a networked device (e.g., router).

MIC (Media Interface Connector) - the optical fiber connector that joins the fiber to the FDDI controller.

MicroChannel - a proprietary 16- or 32-bit bus developed by IBM for its PS/2 computers' internal expansion cards; also offered by others.

MTU (Maximum Transmission Unit) - the largest unit of data that can be sent over a type of physical medium.

Multi-homed - a device that has both an ATM and another network connection, typically Ethernet.

Multiplexing - a function within a layer that interleaves the information from multiple connections into one connection (*see* demultiplexing).

Multipoint Access - user access in which more than one terminal equipment (TE) is supported by a single network termination.

Multipoint-to-Point Connection - a Point-to-Multipoint Connection may have zero bandwidth from the Root Node to the Leaf Nodes, and non-zero return bandwidth from the Leaf Nodes to the Root Node. Such a connection is also known as a Multipoint-to-Point Connection.

Multipoint-to-Multipoint Connection - a collection of associated ATM VC or VP links, and their associated endpoint nodes, with the following properties:

1. All N nodes in the connection, called Endpoints, serve as a Root Node in a Point-to-Multipoint connection to all of the (N-1) remaining endpoints.

2. Each of the endpoints can send information directly to any other endpoint, but the receiving endpoint cannot distinguish which of the endpoints is sending information without additional (e.g., higher layer) information.

Near-End - in a relationship between two devices in a circuit, the near-end device is the one that is local.

Network Module - ATM port interface cards which may be individually added or removed from any *ForeRunner* ATM switch to provide a diverse choice of connection alternatives. Each network module provides between one and six full-duplex ATM physical connections to the *ForeRunner* switch.

NMS (Network Management Station) - the system responsible for managing a network or a portion of a network. The NMS talks to network management agents, which reside in the managed nodes.

NNI (Network-to-Network Interface or Network Node Interface) - the interface between two public network pieces of equipment.

nonvolatile - a term used to describe a data storage device (memory) that retains its contents when power is lost.

NuBus - a high-speed bus used in the Macintosh family of computers, structured so that users can put a card into any slot on the board without creating conflict over the priority between those cards

OAM (Operation and Maintenance) Cell - a cell that contains ATM LM information. It does not form part of the upper layer information transfer.

octet - a grouping of 8 bits; similar, but not identical, to a byte.

OID (Object Identifier) - the address of a MIB variable.

OOF (Out-of-Frame) - a signal condition and alarm in which some or all framing bits are lost.

OpenView - Hewlett-Packard's network management software.

OSI (Open Systems Interconnection) - the 7-layer suite of protocols designed by ISO committees to be the international standard computer network architecture.

OSPF (Open Shortest Path First) Protocol - a routing algorithm for IP that incorporates least-cost, equal-cost, and load balancing.

Out-of-Band Management - refers to switch configuration via the serial port or over Ethernet, not ATM.

packet - a group of bits - including information bits and overhead bits - transmitted as a complete package on a network. Usually smaller than a transmission block.

Packet Port - a port on the *CellPath* 300 that transmits and receives packet traffic.

Packet Switching - a communications paradigm in which packets (messages) are individually routed between hosts with no previously established communications path.

Payload Scrambling - a technique that eliminates certain bit patterns that may occur within an ATM cell payload that could be misinterpreted by certain sensitive transmission equipment as an alarm condition.

PBX (Private Branch Exchange) - a private phone system (switch) that connects to the public telephone network and offers in-house connectivity. To reach an outside line, the user must dial a digit like 8 or 9.

PCI (Peripheral Component Interconnect) - a local-bus standard created by Intel.

PCM (Pulse Code Modulation) - a modulation scheme that samples the information signals and transmits a series of coded pulses to represent the data.

PCR (Peak Cell Rate) - parameter defined by the ATM Forum for ATM traffic management. In CBR transmissions, PCR determines how often data samples are sent. In ABR transmissions, PCR determines the maximum value of the ACR.

PDN (Public Data Network) - a network designed primarily for data transmission and intended for sharing by many users from many organizations.

PDU (Protocol Data Unit) - a unit of data specified in a layer protocol and consisting of protocol control information and layer user data.

Peak Cell Rate - at the PHY Layer SAP of a point-to-point VCC, the Peak Cell Rate Rpis the inverse of the minimum inter-arrival time T0 of the request to send an ATM-SDU.

Peer Entities - entities within the same layer.

PHY (Physical Layer) - the actual cards, wires, and/or fiber-optic cabling used to connect computers, routers, and switches.

Physical Layer (PHY) Connection - an association established by the PHY between two or more ATM-entities. A PHY connection consists of the concatenation of PHY links in order to provide an end-to-end transfer capability to PHY SAPs.

PLCP (Physical Layer Convergence Protocol) - a framing protocol that runs on top of the T1 or E1 framing protocol.

PLM (Physical Layer Module) - interface card in the *CellPath* 300 that provides the logic to support the physical layer of the network link. A PLM has the actual physical port mounted on it. Various PLMs support various physical layers, such as OC-3c/STM1 or DS3.

PLP (Packet Level Protocol) - Network layer protocol in the X.25 protocol stack. Sometimes called X.25 Level 3 or X.25 Protocol. See also X.25.

PM (Protocol Module) - interface card in the *CellPath* 300 that provides the logic supporting the protocol layer of the network link. Various PMs support various protocols, such as ATM cell, Frame Relay, or CBR traffic.

PMD (Physical Medium Dependent) - a sublayer concerned with the bit transfer between two network nodes. It deals with wave shapes, timing recovery, line coding, and electro-optic conversions for fiber based links.

PNNI (Private Network Node Interface or Private Network-to-Network Interface) - a protocol that defines the interaction of private ATM switches or groups of private ATM switches

ping (Packet Internet Groper) - a program used to test reachability of destinations by sending them an ICMP echo request and waiting for a reply.

Point-to-Multipoint Connection - a collection of associated ATM VC or VP links, with associated endpoint nodes, with the following properties:

1. One ATM link, called the Root Link, serves as the root in a simple tree topology. When the Root node sends information, all of the remaining nodes on the connection, called Leaf nodes, receive copies of the information.

2. Each of the Leaf Nodes on the connection can send information directly to the Root Node. The Root Node cannot distinguish which Leaf is sending information without additional (higher layer) information. (See the following note for Phase 1.)

3. The Leaf Nodes cannot communicate directly to each other with this connection type.

Note: Phase 1 signalling does not support traffic sent from a Leaf to the Root.

Point-to-Point Connection - a connection with only two endpoints.

Point of Demarcation - the dividing line between a carrier and the customer premise that is governed by strict standards that define the characteristics of the equipment on each side of the demarcation. Equipment on one side of the point of demarcation is the responsibility of the customer. Equipment on the other side of the point of demarcation is the responsibility of the carrier.

Policing - the function that ensures that a network device does not accept traffic that exceeds the configured bandwidth of a connection.

Primitive - an abstract, implementation-independent interaction between a layer service user and a layer service provider.

Priority - the parameter of ATM connections that determines the order in which they are reduced from the peak cell rate to the sustained cell rate in times of congestion. Connections with lower priority (4 is low, 1 is high) are reduced first.

PROM (Programmable Read-Only Memory) - a chip-based information storage area that can be recorded by an operator but erased only through a physical process.

Protocol - a set of rules and formats (semantic and syntactic) that determines the communication behavior of layer entities in the performance of the layer functions.

Protocol Control Information - the information exchanged between corresponding entities using a lower layer connection to coordinate their joint operation.

Proxy - the process in which one system acts for another system to answer protocol requests.

Proxy Agent - an agent that queries on behalf of the manager, used to monitor objects that are not directly manageable.

PSN (Packet Switched Network) - a network designed to carry data in the form of packets. The packet and its format is internal to that network.

PT (Payload Type) - bits 2...4 in the fourth byte of an ATM cell header. The PT indicates the type of information carried by the cell. At this time, values 0...3 are used to identify various types of user data, values 4 and 5 indicate management information, and values 6 and 7 are reserved for future use.

PVC (Permanent Virtual Circuit (or Channel)) - a circuit or channel through an ATM network provisioned by a carrier between two endpoints; used for dedicated long-term information transport between locations.

Q.2931 - Derived from Q.93B, the narrowband ISDN signalling protocol, an ITU standard describing the signalling protocol to be used by switched virtual circuits on ATM LANs.

Real-Time Clock - a clock that maintains the time of day, in contrast to a clock that is used to time the electrical pulses on a circuit.

Relaying - a function of a layer by means of which a layer entity receives data from a corresponding entity and transmits it to another corresponding entity.

RFCs (Requests For Comment) - IETF documents suggesting protocols and policies of the Internet, inviting comments as to the quality and validity of those policies. These comments are collected and analyzed by the IETF in order to finalize Internet standards.

RFI (Radio Frequency Interference) - the unintentional transmission of radio signals. Computer equipment and wiring can both generate and receive RFI.

RIP (Routing Information Protocol) - a distance vector-based protocol that provides a measure of distance, or hops, from a transmitting workstation to a receiving workstation.

RISC (Reduced Instruction Set Computer) - a generic name for CPUs that use a simpler instruction set than more traditional designs.

Router - a device that forwards traffic between networks or subnetworks based on network layer information.

RTS (Request To Send) - an RS-232 modem interface signal (sent from the DTE to the modem on pin 4) which indicates that the DTE has data to transmit.

SBus - hardware interface for add-in boards in later-version Sun 3 workstations.

SAP (Service Access Point) - the point at which an entity of a layer provides services to its LM entity or to an entity of the next higher layer.

SAR (Segmentation And Reassembly) - the SAR accepts PDUs from the CS and divides them into very small segments (44 bytes long). If the CS-PDU is less than 44 bytes, it is padded to 44 with zeroes. A two-byte header and trailer are added to this basic segment. The header identifies the message type (beginning, end, continuation, or single) and contains sequence numbering and message identification. The trailer gives the SAR-PDU payload length, exclusive of pad, and contains a CRC check to ensure the SAR-PDU integrity. The result is a 48-byte PDU that fits into the payload field of an ATM cell.

SC - *CellPath* 300 System Controller; paired with the Extension Module (EM).

SCR (sustainable cell rate) - parameter defined by the ATM Forum for ATM traffic management. For VBR connections, SCR determines the long-term average cell rate that can be transmitted.

SCSI (Small Computer Systems Interface) - a standard for a controller bus that connects disk drives and other devices to their controllers on a computer bus. It is typically used in small systems.

SDLC (Synchronous Data Link Control) - IBM's data link protocol used in SNA networks.

SDU (Service Data Unit) - a unit of interface information whose identity is preserved from one end of a layer connection to the other.

SEAL (Simple and Efficient Adaptation Layer) - also called AAL 5, this ATM adaptation layer assumes that higher layer processes will provide error recovery, thereby simplifying the SAR portion of the adaptation layer. Using this AAL type packs all 48 bytes of an ATM cell information field with data. It also assumes that only one message is crossing the UNI at a time. That is, multiple end-users at one location cannot interleave messages on the same VC, but must queue them for sequential transmission.

Segment - a single ATM link or group of interconnected ATM links of an ATM connection.

Semipermanent Connection - a connection established via a service order or via network management.

SES (Severely Errored Seconds) - a second during which more event errors have occurred than the SES threshold.

SF (Superframe) - Common framing type used on T1 circuits. SF consists of 12 frames of 192 bits each, with the 193rd bit providing error checking and other functions. SF has been superseded by ESF, but is still widely used. Also called *D4 framing*. See also ESF.

SGMP (Simple Gateway Management Protocol) - the predecessor to SNMP.

Shaping Descriptor - *n* ordered pairs of GCRA parameters (I,L) used to define the negotiated traffic shape of an APP connection. The traffic shape refers to the load-balancing of a network. In this context, load-balancing means configuring the data flows to maximize the efficiency of the network.

SIR (Sustained Information Rate) - the long-term average data transmission rate across the User-to-Network Interface.

SMDS (Switched Multimegabit Data Service) - a high-speed, datagram-based, public data network service expected to be widely used by telephone companies in their data networks.

SMTP (Simple Mail Transfer Protocol) - the Internet electronic mail protocol used to transfer electronic mail between hosts.

SNAP - SubNetwork Access Protocol

SNMP (Simple Network Management Protocol) - the Internet standard protocol for managing nodes on an IP network.

snmpd - an SMNP agent for a given adapter card.

SONET (Synchronous Optical Network) - a new and growing body of standards that defines all aspects of transporting and managing digital traffic over optical facilities in the public network.

Source Traffic Descriptor - a set of traffic parameters belonging to the ATM Traffic Descriptor used during the connection set-up to capture the intrinsic traffic characteristics of the connection requested by the source.

Spanning Tree Protocol - provides loop-free topology in a network environment where there are redundant paths.

SPANS (Simple Protocol for ATM Network Signalling) - FORE Systems' proprietary signalling protocol used for establishing SVCs between FORE Systems equipment.

SPARC (Scalable Processor Architecture Reduced instruction set Computer) - a powerful workstation similar to a reduced-instruction-set-computing (RISC) workstation.

SPE (Synchronous Payload Envelope) - the payload field plus a little overhead of a basic SONET signal.

SPVC (Smart PVC) - a generic term for any communications medium which is permanently provisioned at the end points, but switched in the middle. In ATM, there are two kinds of SPVCs: smart permanent virtual path connections (SPVPCs) and smart permanent virtual channel connections (SPVCCs).

Static Route - a route that is entered manually into the routing table.

Statistical Multiplexing - a technique for allowing multiple channels and paths to share the same link, typified by the ability to give the bandwidth of a temporarily idle channel to another channel.

STM (Synchronous Transfer Mode) - a transport and switching method that depends on information occurring in regular and fixed patterns with respect to a reference such as a frame pattern.

STP (Shielded Twisted Pair) - two or more insulated wires that are twisted together and then wrapped in a cable with metallic braid or foil to prevent interference and offer noise-free transmissions.

STS (Synchronous Transport Signal) - a SONET electrical signal rate.

Sublayer - a logical subdivision of a layer.

Super User - a login ID that allows unlimited access to the full range of a device's functionality, including especially the ability to reconfigure the device and set passwords.

SVC (Switched Virtual Circuit (or Channel)) - a channel established on demand by network signalling, used for information transport between two locations and lasting only for the duration of the transfer; the datacom equivalent of a dialed telephone call.

Switched Connection - a connection established via signalling.

Symmetric Connection - a connection with the same bandwidth value specified for both directions.

Synchronous - signals that are sourced from the same timing reference and hence are identical in frequency.

Systems Network Architecture (SNA) - a proprietary networking architecture used by IBM and IBM-compatible mainframe computers.

T1 - a specification for a transmission line. The specification details the input and output characteristics and the bandwidth. T1 lines run at 1.544 Mbps and provide for 24 data channels. In common usage, the term "T1" is used interchangeably with "DS1."

T3 - a specification for a transmission line, the equivalent of 28 T1 lines. T3 lines run at 44.736 Mbps. In common usage, the term "T3" is used interchangeably with "DS3."

Tachometer - in *ForeView*, the tachometer shows the level of activity on a given port. The number in the tachometer shows the value of a chosen parameter in percentage, with a colored bar providing a semi-logarithmic representation of that percentage.

TAXI (Transparent Asynchronous Transmitter/Receiver Interface) - Encoding scheme used for FDDI LANs as well as for ATM; supports speeds of up to 100 Mbps over multimode fiber.

TC (Transmission Convergence) - generates and receives transmission frames and is responsible for all overhead associated with the transmission frame. The TC sublayer packages cells into the transmission frame.

TCP (Transmission Control Protocol) - a specification for software that bundles and unbundles sent and received data into packets, manages the transmission of packets on a network, and checks for errors.

TCP/IP (Transmission Control Protocol/Internet Protocol) - a set of communications protocols that has evolved since the late 1970s, when it was first developed by the Department of Defense. Because programs supporting these protocols are available on so many different computer systems, they have become an excellent way to connect different types of computers over networks.

TDM (Time Division Multiplexing) - a method of traditional digital multiplexing in which a signal occupies a fixed, repetitive time slot within a higher-rate signal.

Telnet - a TCP / IP protocol that defines a client / server mechanism for emulating directly-connected terminal connections.

Token Ring - a network access method in which the stations circulate a token. Stations with data to send must have the token to transmit their data.

topology - a program that displays the topology of a FORE Systems ATM network. An updated topology can be periodically re-displayed by use of the interval command option.

Traffic - the calls being sent and received over a communications network. Also, the packets that are sent on a data network.

Trailer - the protocol control information located at the end of a PDU.

Transit Delay - the time difference between the instant at which the first bit of a PDU crosses one designated boundary, and the instant at which the last bit of the same PDU crosses a second designated boundary.

trap - a program interrupt mechanism that automatically updates the state of the network to remote network management hosts. The SNMP agent on the switch supports these SNMP traps.

UAS (Unavailable Seconds) - a measurement of signal quality. Unavailable seconds start accruing when ten consecutive severely errored seconds occur.

UBR (Unspecified Bit Rate) - a type of traffic that is not considered time-critical (e.g., ARP messages, pure data), allocated whatever bandwidth is available at any given time. UBR traffic is given a "best effort" priority in an ATM network with no guarantee of successful transmission.

UDP (User Datagram Protocol) - the TCP/IP transaction protocol used for applications such as remote network management and name-service access; this lets users assign a name, such as "RVAX*2,S," to a physical or numbered address.

Unassigned Cells - a generated cell identified by a standardized virtual path identifier (VPI) and virtual channel identifier (VCI) value, which does not carry information from an application using the ATM Layer service.

UNI (User-to-Network Interface) - the physical and electrical demarcation point between the user and the public network service provider.

UNI 3.0 - the User-to-Network Interface standard set forth by the ATM Forum that defines how private customer premise equipment interacts with private ATM switches.

UPC (Usage Parameter Control) - the mechanism that ensures that traffic on a given connection does not exceed the contracted bandwidth of the connection. UPC is responsible for policing or enforcement. UPC is sometimes confused with congestion management, to which it is functionally related on the *CellPath* 300 (*see* congestion management).

UTP (Unshielded Twisted Pair) - a cable that consists of two or more insulated conductors in which each pair of conductors are twisted around each other. There is no external protection and noise resistance comes solely from the twists.

V.35 - ITU-T standard describing a synchronous, physical layer protocol used for communications between a network access device and a packet network. V.35 is most commonly used in the United States and Europe, and is recommended for speeds up to 48 Kbps.

VBR (Variable Bit Rate) - a type of traffic that, when sent over a network, is tolerant of delays and changes in the amount of bandwidth it is allocated (e.g., data applications).

VC (Virtual Channel (or Circuit)) - a communications path between two nodes identified by label rather than fixed physical path.

VCC (Virtual Channel Connection) - a unidirectional concatenation of VCLs that extends between the points where the ATM service users access the ATM Layer. The points at which the ATM cell payload is passed to, or received from, the users of the ATM Layer (i.e., a higher layer or ATMM-entity) for processing signify the endpoints of a VCC.

VCI (Virtual Channel Identifier) - the address or label of a VC; a value stored in a field in the ATM cell header that identifies an individual virtual channel to which the cell belongs. VCI values may be different for each data link hop of an ATM virtual connection.

VCL (Virtual Channel Link) - a means of unidirectional transport of ATM cells between the point where a VCI value is assigned and the point where that value is translated or removed.

VINES (Virtual Network Software) - Banyan's network operating system based on UNIX and its protocols.

Virtual Channel Switch - a network element that connects VCLs. It terminates VPCs and translates VCI values. The Virtual Channel Switch is directed by Control Plane functions and relays the cells of a VC.

Virtual Connection - an endpoint-to-endpoint connection in an ATM network. A virtual connection can be either a virtual path or a virtual channel.

Virtual Path Switch - a network element that connects VPLs, it translates VPI (not VCI) values and is directed by Control Plane functions. The Virtual Path Switch relays the cells of a Virtual Path.

VPT (Virtual Path Terminator) - a system that unbundles the VCs of a VP for independent processing of each VC.

VP (Virtual Path) - a unidirectional logical association or bundle of VCs.

VPC (Virtual Path Connection) - a concatenation of VPLs between virtual path terminators (VPTs). VPCs are unidirectional.

VPDN (Virtual Private Data Network) - a private data communications network built on public switching and transport facilities rather than dedicated leased facilities such as T1s.

VPI (Virtual Path Identifier) - the address or label of a particular VP; a value stored in a field in the ATM cell header that identifies an individual virtual path to which the cell belongs. A virtual path may comprise multiple virtual channels.

VPL (Virtual Path Link) - a means of unidirectional transport of ATM cells between the point where a VPI value is assigned and the point where that value is translated or removed.

VPN (Virtual Private Network) - a private voice communications network built on public switching and transport facilities rather than dedicated leased facilities such as T1s.

VT (Virtual Tributary) - a structure used to carry payloads such as DS1s that run at significantly lower rates than STS-1s.

WAN (Wide-Area Network) - a network that covers a large geographic area.

Warm Start Trap - a *CellPath* 300 SNMP trap that indicates that SNMP alarm messages or agents have been enabled.

Yellow Alarm - an alarm that occurs on a device when the signal from the device is not received at the far-end.

X.21 - ITU-T standard for serial communications over synchronous digital lines. The X.21 protocol is used primarily in Europe and Japan.

X.25 - ITU-T standard that defines how connections between DTE and DCE are maintained for remote terminal access and computer communications in PDNs. X.25 specifies LAPB, a data link protocol, and PLP, a network layer protocol. Frame Relay has, to some degree, superseded X.25. See also Frame Relay, LAPB, and PLP.

Index

A

advanced contact power system . . . . . 1 - 7
air flow around chassis . . . . . 1 - 5

B

backplanes, location of . . . . . 1 - 4
blank face plates . . . . . 2 - 6
blank slot covers . . . . . 1 - 5

C

caution statement, definition of v
chassis
- illustration of . . . . . 1 - 4
- power supplies . . . . . 1 - 6
- powering on . . . . . 2 - 1
- setup . . . . . 2 - 1
- ventilation . . . . . 1 - 5
- warnings . . . . . 2 - 1

E

environmental specifications . . . . . 3 - 3

H

hot swapping
- modules . . . . . 1 - 7
- power supplies . . . . . 1 - 6

I

insert / extract levers, use of . . . . . 2 - 5, 2 - 6
insertion
- advanced contact power system . . . 1 - 7
- modules in an existing chassis . . . . 2 - 4

installation
- ES-4810 chassis . . . . . 2 - 1
- new modules in existing chassis . . . 2 - 4

L

levers on modules, use of . . . . . .2 - 5, 2 - 6

N

note statement, definition of v

P

power connections recommended . . . . . 2 - 3
power cords requirements . . . . . 2 - 1
power supplies
- hot removal . . . . . 1 - 6
- single and dual . . . . . 1 - 6
- specifications . . . . . 3 - 2

power up of chassis . . . . . 2 - 1

R

rack mount requirements . . . . . 1 - 5
removing modules from the chassis . . . . . 2 - 6

S

set up, chassis . . . . . 2 - 1
specifications of chassis . . . . . 3 - 1

V

ventilation of chassis . . . . . 1 - 5

W

warnings
- definition of v
- high voltage in chassis . . . . . 1 - 6
- hot removal of power supplies . . . . 1 - 6
- lifting a fully loaded chassis . . . . . 2 - 1